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Preliminary Yield Functions and Tables for Spruce-Fir Stands of Northwestern Ontario

B. Payandeh

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PRELIMINARY YIELD FUNCTIONS AND TABLES FOR SPRUCE-FIR STANDS OF NORTHWESTERN ONTARIO

BIJAN PAYANDEH

GREAT LAKES FORESTRY CENTRE

CANADIAN FORESTRY SERVICE

GOVERNMENT OF CANADA

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ABSTRACT

Data from 193 semi-permanent growth plots established in the early 1970s in the spruce-fir forest types of northwestern Ontario were analyzed. Stepwise and all possible subset linear regression and nonlinear regression models were used to develop yield functions and tables by stand components.

In general, high and natural variability of the stands resulted in yield equations with low precision. Although the linear mixed models containing up to five variables (three of which were categorical site variables) produced better fits than nonlinear models, the latter were chosen because of flexibility and adaptability to natural growth processes. Extension of the Richards biological growth model was used to represent the natural growth and yield accumulation subject to stand deterioration that was due to overmaturity. None of the categorical site variables proved significant in conjunction with the nonlinear models. Similar model forms and constrained coefficients were used for the total as well as for stand components so as to avoid additivity problems.

The resulting yield equations and tables are in close agreement with those of an earlier work and should serve as preliminary growth and yield information for forest management planning.

RÉSUMÉ

On a analysé les données sur 193 placettes semi-permanentes établies au début des années 1970 sur des terrains forestiers à prédominance de'Epinettes et de Sapins dans le nord-ouest de l'Ontario. On a utilisé des modèles de régression linéaire pas à pas et tous les modèles de régression linéaire possibles sur les sous-ensembles ainsi que des modèles de régression non linéaire pour produire des fonctions et des tables de rendement pour les espèces composant les peuplements.

En général, la variabilité élevée et naturelle des peuplements a donné lieu à des équations de rendement ayant un degré de précision peu élevé. Bien que les modèles linéaires mixtes contenant jusqu'à cinq variables (dont trois étaient des variables nominales liées au site) ont permis d'obtenir de meilleurs ajustements que les modèles non linéaires, on a choisi ces derniers en raison de leur souplesse et de leur capacité à décrire les processus de croissance naturels. On a utilisé une version augmentée du modèle de croissance biologique de Richards pour représenter l'accumulation naturelle de la croissance et du rendement qui est soumise à la détérioration du peuplement qui est au stade du déclin. Aucune des variables nominales liées au site ne s'est avérée significative dans le cas des modèles non linéaires. On a utilisé des formes de modèle similaires et des coefficients de régression soumis à des conditions pour établir les résultats pour l'ensemble ainsi que pour les espèces composant les peuplements afin d'éviter des problèmes d'additivité.

Les équations et les tables de rendement donnent des resultats assez similaires à ceux établis lors de travaux précédents, et on devrait s'en servir comme données préliminaires sur la croissance et le rendement pour planifier l'aménagement forestier.

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INTRODUCTION

More than 3 million ha of Ontario's productive forest lands are classified in the spruce-fir forest types. A spruce-fir type is defined as having at least 60% coniferous content by volume--mainly white spruce *(Picea glauca* [Moench] Voss), black spruce *(P. mariana* [Mill.] B.S.P.), and balsam fir *(Abies balsamea* [L.] Mill.). Forty percent or less is hardwood, white birch *(Betula papyrifera* Marsh.), balsam poplar *(Populus balsamifera* L.), and trembling aspen *(Populus tremuloides* Michx.). The gross volume of these cover types is estimated at about 700 million m^3. At present the annual harvest is less than the calculated allowable cut for these forest types. However, as wood supplies diminish in Canada and as forests are used more and more for recreational purposes, greater demands will be placed on the spruce-fir forest types in Ontario.

Because of the complexity of the spruce-fir forest types and a lack of research resources, very little information is available on the extent, species composition, growth, yield and other mensurational characteristics of these types. Such information is essential in the determination of management potential.

Bedell and MacLean (1952) and MacLean and Bedell (1955) have reported on one of the earlier growth and yield studies in northern Ontario's mixedwood stands. Evert (1975) published separate stand development curves and tables for each of the two companies (American Can of Canada Ltd. and Kimberly-Clark of Canada Ltd.) involved in establishing and maintaining the growth plots. Evert (1976a) further prepared variable density yield tables for the jack pine *(Pinus banksiana* Lamb.) cover type for three broad site classes. Evert (1976b) also developed equations and tables showing loss of volume as a result of regular mortality for the five cover types identified within the mixedwood forest types.

Yield functions and tables were developed recently (Payandeh and Field 1986) on the basis of the above-mentioned data sets and nonlinear regression models. Such tables should provide generalized yield information for a broad range of site conditions and species composition.

To provide mensurational information on growth and yield, by major species group and size class combination for the spruce-fir stands of northern Ontario, an assessment was undertaken at the Great Lakes Forestry Centre. The purpose of this report is to present preliminary growth and yield tables and equations useful in the management of this important forest resource in the province of Ontario.

MATERIALS AND METHODS

Between 1970 and 1974, 193 semipermanent growth plots (points) were established at three main locations: the Black Sturgeon Lake area northeast of Thunder Bay (Fig. 1), the Beardmore area north of Nipigon, and the Searchmont area north of Sault Ste. Marie. All plots were located within stands 2 ha in area or larger without significant gaps in the canopy. The plots covered a wide range of stand ages, species composition, densities, site indices, etc., as indicated in Table 1.

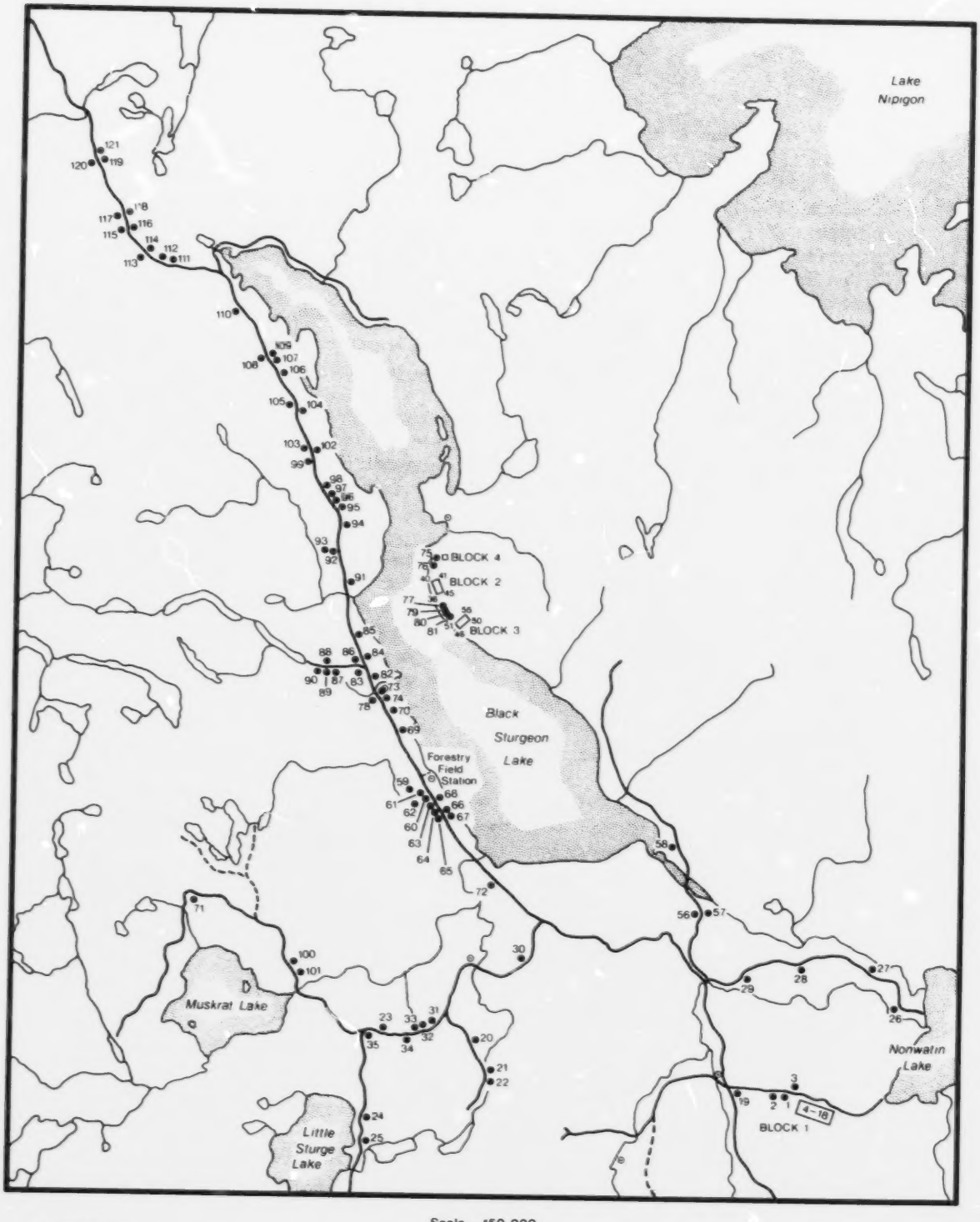

Figure 1. Location of semipermanent growth plots established near Black Sturgeon Lake.

Table 1. Statistical summary of the semipermanent growth plots of spruce-fir forest types of northwestern Ontario by stand component.

Stand characteristics	Minimum	Maximum	Mean	Standard deviation	CV(%)[a]
		Conifer component			
Diameter (cm)	4.07	36.65	15.00	6.21	41.41
Height (m)	5.35	20.47	13.24	3.06	23.11
Age (year)	23.00	126.00	53.11	21.56	40.59
Site index (m)	9.38	25.74	16.41	3.08	18.77
No. of trees/ha	65.94	17,753.26	2,097.45	1,932.75	92.15
Total basal area (m^2/ha)	2.30	78.05	23.93	14.67	61.30
Merchantable basal area (m^2/ha)	2.30	72.31	19.09	13.65	71.50
Total volume (m^3/ha)	9.89	495.32	133.01	83.00	62.40
Merchantable volume (m^3/ha)	0.00	405.63	99.31	75.46	76.00
		Total			
Diameter (cm)	4.04	37.33	15.02	5.95	39.60
Height (m)	5.35	21.58	14.15	2.85	20.14
Age (year)	23.00	126.00	52.97	21.57	40.71
Site index (m)	9.38	25.74	16.44	3.09	18.80
No. of trees/ha	150.38	18,211.26	2,726.45	2,115.91	77.61
Total basal area (m^2/ha)	6.89	99.86	32.00	14.74	46.06
Merchantable basal area (m^2/ha)	2.30	91.82	25.21	14.44	57.31
Total volume (m^3/ha)	47.67	408.27	181.52	72.46	39.91
Merchantable volume (m^3/ha)	13.63	346.59	136.82	72.94	53.31

[a]Coefficient of variation percent

Horizontal point sampling (Beers and Miller 1964, Husch et al. 1982) with a 5, 10 or 20 basal area factor (1.15, 2.30 and 3.44 m^2/ha) was used to establish the plots. The choice of basal area factor was according to the stand size and density such that, on the average, 8-15 trees per plot were included.[1] In most cases, a basal area factor of 10 (2.3 m^2/ha) was used.

A Spiegal relascope with automatic slope correction was used for tree tallies. All borderline trees were checked by tape to ensure their status. All "in" trees were marked with white paint at breast height (1.30 m) so that current and subsequent measurements could be taken at the same point. All tallied trees in the plot were numbered with aluminum tags facing the plot center, which

[1]Application of variable basal area factor was considered at the beginning to optimize the number of "in" trees per plot. This practice was abandoned after the first field season when it was realized that not only would it increase the sample variability but it might also introduce bias to the estimator and increase variability under consideration.

was marked with a 1-m-high aluminum stake. Horizontal distance from tree center (at DBH) and plot center and bearings of at least three tallied trees were recorded as an aid in possible relocation of "lost" plot centers at remeasurement.

An example of a plot tally sheet and data collected is given in Appendix A. In brief, the data gathered and/or recorded included: plot number; location by township; major species, secondary species and minor species (determined from tree tally as the most frequently, second most frequently and third most frequently tallied species on the plot, respectively); basal area factor used; average stand age (i.e., average age of at least three dominant trees in the stand taken at 30-cm stump height with a 30-cm increment borer). Plot data also included information on land form, slope %, slope position, slope length, aspect, soil series, soil moisture, soil texture and soil permeability. Major stand disturbances, approximate date of disturbance and ground vegetation were also recorded. Appendix B gives a detailed description of the above variables (mostly categorical) and the number of classes to which they were reduced[2] for the final analysis.

For each "in" tree, the data included tree number, species code, and tree status, according to Beers and Miller (1964). Tree diameter (DBH) was measured to the nearest 2.5 mm with a diameter tape. Defects in each tree, if any, were recorded. On each plot three to five dominant and codominant trees were selected for detailed measurements. Total tree height (HT) was measured to the nearest 30 cm with sectional measuring poles for trees less than 10 m and a Spiegal relascope for taller trees. Crown diameter (CD) was estimated to the nearest 30 cm. Crown length (CL), the distance from the tip of the tree to the general level of live branches, was also measured to the nearest 30 cm, with either a height-measuring pole or a Spiegal relascope. Tree form was measured as the ratio of diameter (outside bark at a height of 5 m) to DBH. The upper diameter measurement was taken with a Pentaprism caliper. Double bark thickness at DBH was measured to the nearest 2.5 mm with a Swedish bark gauge. Each tree was placed in one of 10 crown classes and one of three crown condition classes (see Appendix B). Tree age (A) was determined from increment borings taken at 30 cm stump height.

Total (TV) and merchantable (MV) tree volumes were calculated according to tree volume equations of Honer et al. (1983). Merchantable volume was based on a stump height of 15 cm and a minimum top diameter of 7.5 cm. Plot site indices were calculated on the basis of existing site index (index age 50 years) equations (Payandeh 1977) for the major Canadian timber species. When a site index equation for a species was not available, an equation for another species similar in growth pattern was employed. For example, the site index equation for balsam poplar was used for both trembling aspen and balsam poplar. The average site index per plot was calculated on the basis of two or three trees within that plot.

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[2]Combining classes of categorical variables because of similarities and/or low frequencies is necessary for regression analysis. Since each class represented by a dummy variable carries one degree of freedom regardless of its frequency, classes with low frequencies should be avoided; otherwise, they would influence the resulting regression relationship disproportionately.

Various growth and yield components were calculated on an individual-tree[3] basis and on a stand basis, and for the two major species components (i.e., conifers and hardwoods) of the stand. Both linear and nonlinear regression models were employed. In the case of linear models, stepwise and all possible subset regression analyses were used, with dummy variables representing the categorical variables. In general, the following linear regression models were used for the yield components of the stand:

A) $Y = F$ (site variables only) (1)

B) $Y = F$ (site variables, site index, stand age, diameter, density and basal area) (2)

C) $\ln Y = F$ (as in B above plus ln transformations) (3)

where site variables in the above models were mostly categorical type variables and included land form, soil moisture, soil texture, slope %, ground cover, crown class and crown condition, etc., as summarized in Appendix B.

The nonlinear regression models (Draper and Smith 1966, Ratkowsky 1983) were based mainly on an extension of the Richards growth functions (Richards 1959) to remove their asymptotic constraint. Such modification would allow the expression of maximum yield for various stand components at the age at which mean annual increment culminates. For example, the model for stand total basal area is given below:

$$G_t = \beta_1 S^{\beta_2}(1-e^{-\beta_3 T})^{\beta_4} e^{-\beta_5 T} + E \qquad (4)$$

where:
G_t = total basal area (m^3/ha)
S = site index (m)
T = stand age (years)
β_1-β_5 = parameters of the model
E = error term of the model

Because of the high natural variability of the data and the sampling procedures employed (Husch et al. 1982, Martin 1983), no attempt was made to force model additivity among the yield components (Burkhart and Sprintz 1984, Cunia and Briggs 1984, Chiyenda and Kozak 1984, Reed and Green 1985). However, in the case of the nonlinear models, parameter estimates were constrained so as to avoid violating model additivity where possible.

RESULTS AND DISCUSSION

Table 1 provides the statistical summary, by stand component, of the data set used. It should be noted that most stand characteristics are highly variable, as indicated by the magnitude of the coefficients of variation (Col. 6, Table 1). Although the resulting yield equations from the constrained non-linear regression models produced somewhat poorer fit than their linear counterparts, nevertheless they were chosen because of the following shortcomings of the linear equations:

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[3]Payandeh, B. 1987. Regression equations on growth and yield attributes for major tree species within the spruce-fir forest type of northern Ontario. (manuscript in preparation)

a) stand age accounted only for a small portion of the variability where it was included in the yield equations;

b) site index and stand age were not included as significant variables in stand density and total basal area equations;

c) one to three qualitative variables were included in some of the yield equations as significant variables accounting for up to 9% of the variability in the response variable.

For the above reasons it was not possible to construct standard yield tables, i.e., yield components expressed by site index and age. In addition, the nonlinear models were chosen because of their flexibility (cf. Payandeh 1983) and ability to describe growth and deterioration of a stand.

Table 2 summarizes the resulting nonlinear regression models expressing various yield characteristics as functions of site index, stand age and other variables. Inclusion of categorical site variables did not prove significant in conjunction with the nonlinear models. Because of the relatively low precision obtained as a result of heterogeneity of the data and sampling errors, and for other reasons described earlier, forcing model additivity was not considered necessary. Nevertheless, the hardwood component was calculated by subtraction rather than by independent model estimation so as to satisfy additivity.

A set of preliminary yield tables for site indices of 5, 10, 15, 20, 25 and 30 m was generated on the basis of the yield equations. Appendix C provides such tables. Figures 2 and 3 show stand development for an average site (i.e., site index = 15 m) for the major site characteristics.

Tables C1-C6 of Appendix C and Figures 2 and 3 clearly indicate the effect of site productivity on mean annual increment, and its inverse effect on the age at which mean annual increment culminates by stand components. Rotation age is often chosen to coincide with the age at which mean annual volume increment culminates, because at this age the stand will yield the maximum possible volume per hectare per year. Therefore, the results presented here may serve to determine both the rate of volume increment and rotation age for a given site.

Equations and tables presented here complement earlier work by Payandeh and Field (1986), and Evert (1975, 1976a and 1976b) by providing growth and yield information for the spruce-fir forest types of northwestern Ontario. The present results, however, may have a broader application since they provide yield estimates by stand components and are based on a data set covering a larger area of the province.

Table 2. Summary of nonlinear regression equations expressing various yield characteristics of spruce-fir forest types of northwestern Ontario by stand component.

Yield characteristics	Regression equation[a]	$\overline{R}^2$	Standard error
	Conifer component		
Avg stand ht (m)	$N = 1.7953S^{0.8128}(1-e^{-0.0482T})^{2.0616}$	0.38	2.54
No. of trees/ha	$N = 4803.6S^{-0.245}(1-e^{0.105T})-8.563e^{-0.0047T}$	0.31	16.78
Total basal area (m^2/ha)[b]	$G_t = 18.556S^{0.2913}(1-e^{-0.0603T})^{2.11}e^{-0.0029T}$	0.40	10.23
Merch. basal area (m^2/ha)[c]	$Gm = 0.789G_t^{1.032}(1-e^{-0.0712T})^{2.612}$	0.87	4.99
Total vol. (m^3/ha)[b]	$V_t = 1.028S^{0.769}G_t^{0.948}(1-e^{-0.0396T})^{2.742}$	0.64	51.39
Merch. vol. (m^3/ha)[c]	$Vm = 0.674V_t^{1.058}(1-e^{-0.0607T})^{2.51}$	0.93	19.43
	Total stand		
Avg stand ht (m)	$H = 1.7640S^{0.8544}(1-e^{-0.0264T})^{0.9005}$	0.50	1.99
No. of trees/ha	$N = 5763.42S^{-0.251}(1-e^{-0.0931T})-6.968e^{-0.0048T}$	0.33	15.67
Total basal area (m^2/ha)[b]	$G_t = 18.633S^{0.2932}(1-e^{-0.0606T})^{2.2}e^{-0.0016T}$	0.41	11.28
Merch. basal area (m^2/ha)[c]	$Gm = 0.797G_t^{1.031}(1-e^{-0.0693T})^{2.543}$	0.88	5.22
Total vol. (m^3/ha)[b]	$V_t = 0.827S^{0.832}G_t^{0.986}(1-e^{-0.0343T})^{1.434}$	0.48	64.57
Merch. vol. (m^3/ha)[c]	$Vm = 0.650V_t^{1.059}(1-e^{-0.601T})^{2.53}$	0.89	24.19

[a] N = no. of trees/ha
S = site index (m)
T = stand age (years)
G_t = total basal area (m^2/ha)
G_m = merch. basal area (m^2/ha)
V_t = total vol. (m^3/ha)
V_m = merch. vol. (m^3/ha)

[b] Includes basal area and volume of all trees >1.5 cm DBH in the stand.

[c] Includes basal area and volume of all trees ⩾10 cm DBH in the stand. Volume based on 30-cm stump height and up to 7.5-cm top diameter.

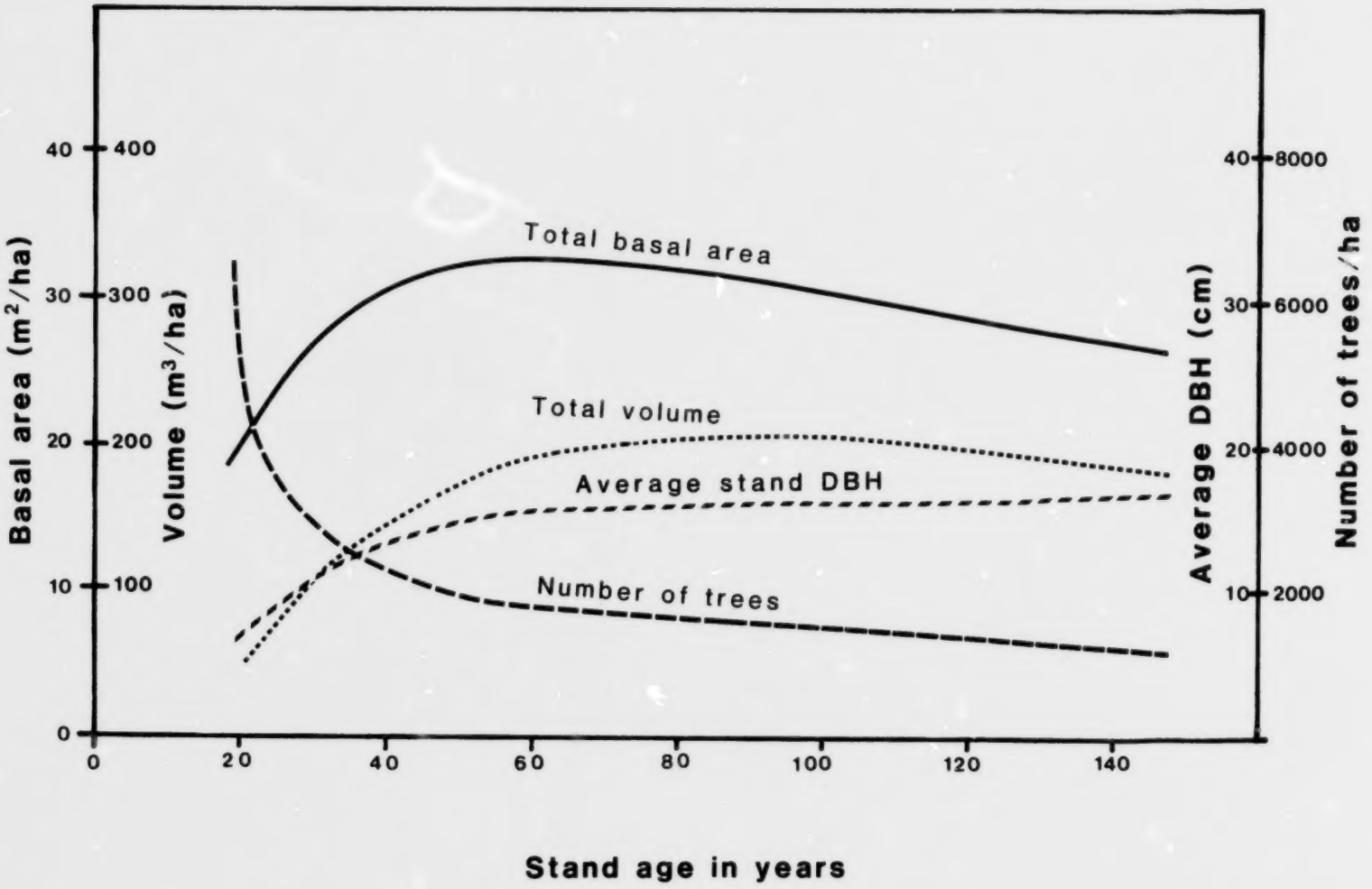

Figure 2. Plotting of total basal area, total volume, average DBH and number of trees/ha against stand age (years) for the conifer component of the spruce-fir stands of northwestern Ontario for a site index of 15 m.

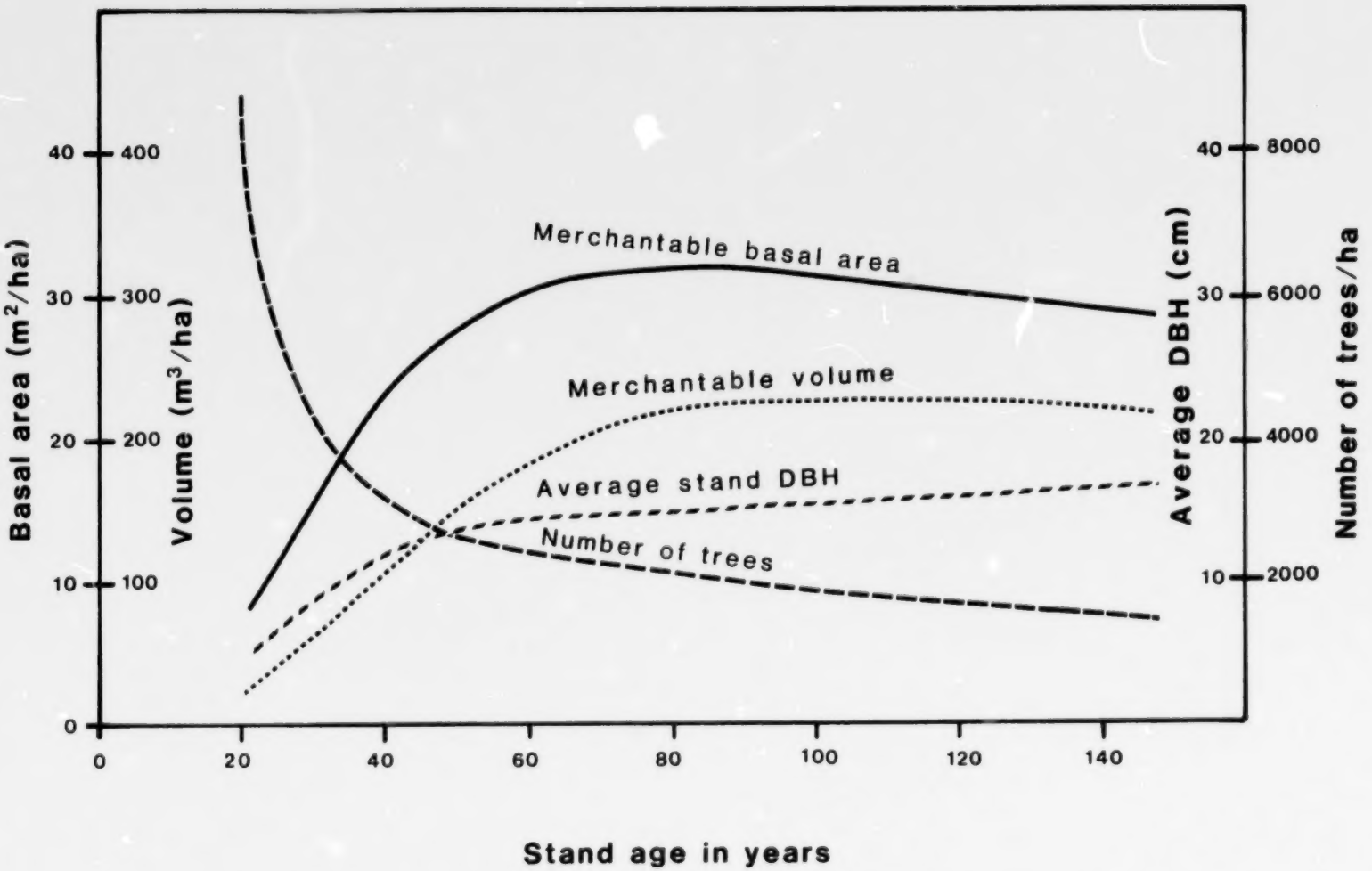

Figure 3. Plotting of merchantable basal area, merchantable volume, average stand DBH and number of trees/ha for total stand against stand age (years) for the spruce-fir forest types of northwestern Ontario for a site index of 15 m.

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APPENDICES

APPENDIX A

An example of a plot tally sheet for preliminary growth and yield assessment of spruce-fir forest types of northwestern Ontario.

Crew **Crozier, Dunn** Date **30** Day **7** Month 19**75** Location: **B.S.L.**

Plot No. [1] **024** Township [4] **01** Major sp. [6] **03** 2nd sp. [8] **07** county-district Minor sp. [10] ____

BAF [12] **2** Avg stand age [13] **41** Site: Landform [16] **7** Slope % [17] **17** Slope position [19] **5**

Slope length [20] **21** Aspect [22] **6** Soil series [23] ____ Soil moisture [25] **3**

Soil texture [26] **01** Soil permeability [28] ____ Disturbance [29] **0** Date [30] ____ Ground cover [32] **3**

Tree No.	Species	Tree status	DBHob	Defects	Total height	Tree form	Double bark thickness	Crown class	Crown condition	Crown width	Height to live crown	Distance to nearest neighbor	Tree age
33 34	35	36	37 38 39 40	41 42	43 44 45	46 47	48 49 50	51	52	53 54	55 56	57 58 59	60 61 62 63 64
01	03	1	231										
02	03	1	375	90	287	77	342	1	0	41	5	35	49
03	03	1	507	90	397	73	292	1	0	51	2	38	35
04	03	1	360										
05	02	1	659										
06	03	1	353										
07	07	1	748										
08	03	1	318										
09	03	1	237										
10	03	1	204										
11	07	1	597										
12	03	1	408	90	316	88	332	1	0	51	4	36	40
13	03	1	321										
49	03	5	212										
50	03	5	350										
51	03	5	317										
52	03	5	236										
53	03	5	425										
54	03	5	397										

Plot Radius Factors: 5 BAF = 4.899; 10 BAF = 2.750; 20 BAF = 1.945 feet.

Location notes; marked tree, species, size, distance, etc.
Distance from plot center:

D.N.T. - #10 - 0.8′

12 - S 68 °E - 3.9′
2 - S 31°W - 5.2′
11 - N 44 °E - 13.2′

APPENDIX B

Initial description and codes for site and soil factors and lesser vegetation, and final categorical and dummy variables used for the spruce-fir data set.

Initial codes and description		Final categorical and dummy variables
Code	Description	
	Landform	
1	Glacio-lacustrine plain (sand and gravel)	landform class 1 [DLF1 DLF2] = [1 0]
2	Glacio-lacustrine (silt and clay)	
3	Littoral landscape (dunes, beaches and bars)	
4	Moraine landscape (ground and recessional moraines, drumlins, knob and kettle ridge)	landform class 2 [DLF1 DLF2] = [0 1]
5	Flattened till plain	landform class 3 [DLF1 DLF2] = [0 0]
6	Glacio-fluvial deposits (meltwater stream beds and outwash plains)	
7	Esker and kame landscape	
8	Limestone plain	
9	Other bedrock landscape	
0	Bog and swamp	

(cont'd)

Initial description and codes for site and soil factors and lesser vegetation, and final categorical and dummy variables used for the spruce-fir data set.

Initial codes and description		Final categorical and dummy variables
Code	Description	
	Soil Moisture	
1	Dry	soil moisture class 1 [DSM1 DSM2] = [1 0]
2	Moderately dry	
3	Moderately fresh	
4	Fresh	soil moisture class 2 [DSM1 DSM2] = [0 1]
5	Very fresh	soil moisture class 3 [DSM1 DSM2] = [0 0]
6	Moderately moist	
7	Moist	
8	Very moist	
9	Wet	
0	Very wet	
	Soil Texture	
1	Gravel - particles larger than a pinhead	soil texture class 1 [DST1 DST2] = [1 0]
2	Sand - particles visible; soil gritty, lacks cohesion and runs free when dry	soil texture class 2 [DST1 DST2] = [0 1]

(cont'd)

Initial description and codes for site and soil factors and lesser vegetation, and final categorical and dummy variables used for the spruce-fir data set.

Initial codes and description		Final categorical and dummy variables
Code	Description	
	Soil Texture (cont'd)	
3	Silt - particles barely visible, floury; moist, forms spindles, not ribbons; cohesive and not adhesive	soil texture class 3 [DST1 DST2] = [0 0]
4	Sandy loam - soil squeezed in hand falls apart; when moist forms a cast that breaks if not handled carefully; individual sand grains can be readily seen	
5	Loam - soil slightly plastic when moist, but not greasy; gritty when dry, not floury; brown or dark grey	
6	Silt loam - soil greasy when moist, floury when dry; on wetting it runs together and puddles; light grey to nearly white	
7	Sandy clay loam - individual sand grains can be seen and felt readily; moist soil friable; usually brownish yellow to red	
8	Silty clay loam - soil heavy and greasy when moist; dull grey, sometimes containing iron concretions	
9	Clay loam - soil mellow and greasy when moist; usually yellowish brown to reddish brown	

(cont'd)

Initial description and codes for site and soil factors and lesser vegetation, and final categorical and dummy variables used for the spruce-fir data set.

Initial codes and description		Final categorical and dummy variables
Code	Description	
	Soil Texture (concl.)	
10	Sandy loam - individual sand grains can be seen and felt readily; moist soil somewhat friable; usually bright red or yellow	soil texture class 3 [DST1 DST2] = [0 0]
11	Silty clay - sand not evident; moist soil plastic; usually grey, sometimes containing iron concretions	
12	Clay - sand not evident; moist soil plastic; usually dark red, often mottled with grey or yellow	
	Slope	
	Initially measured in % (>5%)	slope class 1 DSL1 = [1]
	Initially measured in % (≤5%)	slope class 2 DSL2 = [0]
	Ground Cover	
1	shrub	lesser vegetation class 1 [DGC1 DGC2] = [1 0]
2	herb	lesser vegetation class 2 [DGC1 DGC2] = [0 1]
3	moss	lesser vegetation class 3 [DGC1 DGC2] = [0 0]

(cont'd)

APPENDIX B (concl.)

Initial description and codes for site and soil factors and lesser vegetation, and final categorical and dummy variables used for the spruce-fir data set.

Initial codes and description		Final categorical and dummy variables
Code	Description	
	Tree crown condition	
1	Good - at least 2/3 filled, with foliage of healthy green color and normal size	Crown condition 1 DCC1 = [1]
2	Medium	Crown condition 2 DCC2 = [0]
3	Poor - less than 1/3 filled, with foliage of poor color and less than normal size	
	Tree crown class	
1	Dominant	dominant DCL1 = [1]
2	Codominant	nondominant DCL2 = [0]
3	Intermediate	
4	Suppressed	
5	Regeneration (undergrowth)	
6	Understory tree	
7	Understory suppressed	
8	Open grown	
9	Others	

APPENDIX C

Table C1. Estimates of preliminary yield per hectare for spruce-fir forest types of northwestern Ontario by stand components.

SITE INDEX: 5

Stand age (yr)	Species component	Density (trees/ha)	DBH[a] (cm)	Height (m)	Basal area (m^2) (>1.5 cm)	Basal area (m^2) (≥10 cm)	Volume (m^3) (>1.5 cm)	Volume (m^3) (≥10 cm)	CAI (m^3)	PAI (m^3)
20	conifer	8646	4.4	2.7	13.2	5.5	14.3	4.5	0.0	0.7
	hardwood[b]	3084	3.5	3.8	0.1	0.0	0.5	0.1	0.0	0.0
	total	11730	3.8	3.4	13.3	5.5	14.8	4.6	0.0	0.7
30	conifer	3921	7.8	4.1	18.6	11.6	30.1	15.3	1.6	1.0
	hardwood	1432	6.3	4.6	0.6	0.4	0.8	0.4	0.0	0.0
	total	5354	6.8	4.5	19.3	12.0	30.9	15.7	1.6	1.0
40	conifer	2926	9.7	5.2	21.7	16.1	43.9	28.0	1.4	1.1
	hardwood	969	8.1	5.2	1.2	0.9	1.4	1.1	0.1	0.0
	total	3895	8.6	5.2	22.8	17.0	45.3	29.1	1.4	1.1
50	conifer	2566	10.7	5.9	23.1	18.7	53.6	38.7	1.0	1.1
	hardwood	781	9.2	5.7	1.7	1.4	2.5	2.1	0.1	0.0
	total	3347	9.7	5.8	24.7	20.1	56.1	40.7	1.1	1.1
60	conifer	2378	11.2	6.4	23.5	19.8	59.7	45.8	0.6	1.0
	hardwood	686	9.9	6.2	2.1	1.9	3.7	3.3	0.1	0.1
	total	3064	10.3	6.2	25.6	21.7	63.4	49.1	0.7	1.1
70	conifer	2245	11.5	6.7	23.5	20.1	63.1	50.1	0.3	0.9
	hardwood	629	10.3	6.5	2.4	2.5	4.9	4.5	0.2	0.1
	total	2874	10.7	6.6	25.9	22.4	68.0	54.6	0.5	1.0
80	conifer	2134	11.7	6.9	23.1	20.0	64.6	52.2	0.2	0.8
	hardwood	588	10.6	6.8	2.7	2.5	6.2	5.8	0.1	0.1
	total	2723	11.0	6.8	25.8	22.5	70.8	57.9	0.3	0.9
90	conifer	2034	11.9	7.0	22.6	19.6	64.9	52.9	0.0	0.7
	hardwood	554	10.9	7.1	3.0	2.7	7.3	6.8	0.1	0.1
	total	2589	11.2	7.0	25.6	22.5	72.2	59.7	0.1	0.8
100	conifer	1940	12.0	7.1	22.1	19.2	64.4	52.8	0.0	0.6
	hardwood	525	11.1	7.2	3.2	3.1	8.4	7.8	0.1	0.1
	total	2465	11.4	7.2	25.3	22.3	72.8	60.6	0.1	0.7
110	conifer	1850	12.2	7.1	21.5	18.7	63.5	52.1	-0.1	0.6
	hardwood	498	11.4	7.4	3.5	3.3	9.3	8.7	0.1	0.1
	total	2348	11.6	7.3	25.0	22.0	72.8	60.8	0.0	0.7
120	conifer	1765	12.3	7.2	20.9	18.2	62.3	51.1	-0.1	0.5
	hardwood	472	11.6	7.5	3.7	3.5	10.2	9.4	0.1	0.1
	total	2238	11.8	7.4	24.6	21.7	72.5	60.6	0.0	0.6
130	conifer	1684	12.4	7.2	20.3	17.6	61.0	50.0	-0.1	0.5
	hardwood	448	10.5	7.6	3.9	3.7	10.9	10.1	0.1	0.1
	total	2133	12.0	7.5	24.2	21.3	71.9	60.1	-0.1	0.6
140	conifer	1607	12.5	7.2	19.8	17.1	59.5	48.8	-0.1	0.4
	hardwood	426	12.1	7.7	4.1	3.9	11.6	10.7	0.1	0.1
	total	2033	12.2	7.5	23.9	21.0	71.2	59.5	-0.1	0.5
150	conifer	1533	12.6	7.2	19.2	16.6	58.1	47.5	-0.1	0.4
	hardwood	404	12.3	7.7	4.3	4.0	12.2	11.2	0.1	0.1
	total	1938	12.4	7.6	23.5	20.6	70.3	58.7	-0.1	0.5

[a]Average stand DBH is derived from estimated total basal area and the number of trees/ha.

[b]Hardwood yield component is derived by subtraction to maintain additivity.

APPENDIX C

Table C2. Estimates of preliminary yield per hectare for spruce-fir forest types of northwestern Ontario by stand components.

SITE INDEX: 10

Stand age (yr)	Species component	Density (trees/ha)	DBH[a] (cm)	Height (m)	Basal area (m^2) (>1.5 cm)	Basal area (m^2) (≥10 cm)	Volume (m^3) (>1.5 cm)	Volume (m^3) (≥10 cm)	CAI (m^3)	PAI (m^3)
	conifer	7295	5.3	4.9	16.2	6.8	29.5	9.6	0.0	1.5
20	hardwood[b]	2561	3.6	7.3	0.1	0.0	2.6	0.9	0.0	0.1
	total	9857	4.6	6.5	16.3	6.8	32.1	10.5	0.0	1.6
	conifer	3309	9.4	7.5	22.8	14.3	62.1	32.8	3.3	2.1
30	hardwood	1190	7.6	8.9	0.8	0.5	5.1	2.8	0.2	0.2
	total	4499	8.2	8.4	23.6	14.8	67.2	35.7	3.5	2.2
	conifer	2469	11.7	9.5	26.5	19.9	90.5	60.4	2.8	2.3
40	hardwood	804	9.8	10.1	1.5	1.1	8.0	5.9	0.3	0.2
	total	3273	10.4	9.9	28.0	21.0	98.5	66.3	3.1	2.5
	conifer	2165	12.9	10.8	28.2	23.0	110.6	83.2	2.0	2.2
50	hardwood	647	11.1	11.0	2.1	1.8	11.3	9.5	0.3	0.2
	total	2813	11.7	10.9	30.3	24.8	121.9	92.7	2.3	2.4
	conifer	2006	13.5	11.6	28.8	24.4	123.2	98.6	1.3	2.1
60	hardwood	568	11.9	11.8	2.6	2.3	14.6	13.2	0.3	0.2
	total	2575	12.5	11.8	31.4	26.7	137.8	111.8	1.6	2.3
	conifer	1894	13.9	12.2	28.7	24.8	130.1	107.7	0.7	1.9
70	hardwood	520	12.4	12.5	3.0	2.8	17.8	16.6	0.3	0.3
	total	2415	12.9	12.4	31.7	27.6	147.9	124.4	1.0	2.1
	conifer	1801	14.1	12.5	28.3	24.6	133.2	112.3	0.3	1.7
80	hardwood	486	12.8	13.1	3.4	3.2	20.7	19.6	0.3	0.3
	total	2288	13.3	12.9	31.6	27.8	153.9	131.9	0.6	1.9
	conifer	1716	14.3	12.7	27.7	24.2	133.9	113.8	0.1	1.5
90	hardwood	458	13.2	13.5	3.7	3.5	23.2	22.2	0.3	0.3
	total	2175	13.6	13.3	31.4	27.7	157.1	136.0	0.3	1.7
	conifer	1637	14.5	12.9	27.0	23.6	132.9	113.5	-0.1	1.3
100	hardwood	434	13.5	13.9	4.0	3.8	25.5	24.4	0.2	0.3
	total	2071	13.8	13.6	31.0	27.4	158.4	137.9	0.1	1.6
	conifer	1561	14.6	13.0	26.3	23.0	131.0	112.1	-0.2	1.2
110	hardwood	412	13.8	14.2	4.3	4.1	27.4	26.3	0.2	0.2
	total	1973	14.1	13.8	30.6	27.1	158.4	138.4	0.0	1.4
	conifer	1489	14.8	13.0	25.6	22.4	128.6	110.1	-0.2	1.1
120	hardwood	391	14.0	14.4	4.6	4.3	29.1	27.8	0.2	0.2
	total	1880	14.3	13.9	30.2	26.7	157.7	137.9	-0.1	1.3
	conifer	1421	14.9	13.0	24.9	21.7	125.8	107.6	-0.3	1.0
130	hardwood	371	14.3	14.6	4.8	4.6	30.6	29.2	0.1	0.2
	total	1792	14.5	14.1	29.7	26.3	156.4	136.8	-0.1	1.2
	conifer	1356	15.1	13.1	24.2	21.1	122.8	105.0	-0.3	0.9
140	hardwood	352	14.6	14.7	5.1	4.8	31.9	30.4	0.1	0.2
	total	1708	14.8	14.2	29.2	25.9	154.8	135.4	-0.2	1.1
	conifer	1293	15.2	13.1	23.5	20.5	119.8	102.3	-0.3	0.8
150	hardwood	334	14.9	14.8	5.3	5.0	33.1	31.4	0.1	0.2
	total	1628	15.0	14.2	28.8	25.5	152.9	133.7	-0.2	1.0

[a]Average stand DBH is derived from estimated total basal area and the number of trees/ha.

[b]Hardwood yield component is derived by subtraction to maintain additivity.

APPENDIX C

Table C3. Estimates of preliminary yield per hectare for spruce-fir forest types of northwestern Ontario by stand components.

SITE INDEX: 15

Stand age (yr)	Species component	Density (trees/ha)	DBH[a] (cm)	Height (m)	Basal area (m^2)		Volume (m^3)		CAI (m^3)	PAI (m^3)
					(>1.5 cm)	(≥10 cm)	(>1.5 cm)	(≥10 cm)		
	conifer	6605	5.9	6.9	18.2	7.7	45.1	15.1	0.0	2.3
20	hardwood[b]	2297	4.7	10.7	0.2	0.0	5.5	1.8	0.0	0.3
	total	8903	5.1	9.4	18.4	7.7	50.6	17.0	0.0	2.5
	conifer	2996	10.5	10.7	25.7	16.2	94.9	51.4	5.0	3.2
30	hardwood	1067	8.5	12.9	0.9	0.5	11.0	6.4	0.5	0.4
	total	4064	9.1	12.2	26.6	16.7	105.9	57.8	5.5	3.5
	conifer	2236	13.0	13.4	29.8	22.4	138.2	94.5	4.3	3.5
40	hardwood	720	11.0	14.7	1.7	1.3	17.0	12.7	0.6	0.4
	total	2956	11.7	14.3	31.5	23.7	155.2	107.2	4.9	3.9
	conifer	1960	14.4	15.3	31.8	26.0	169.0	130.3	3.1	3.4
50	hardwood	580	12.4	16.1	2.4	2.0	23.1	19.7	0.6	0.5
	total	2540	13.1	15.9	34.1	28.0	192.1	150.0	3.7	3.8
	conifer	1816	15.1	16.5	32.4	27.6	188.1	154.4	1.9	3.1
60	hardwood	509	13.3	17.3	2.9	2.6	29.0	26.5	0.6	0.5
	total	2325	13.9	17.1	35.3	30.2	217.1	181.0	2.5	3.6
	conifer	1715	15.5	17.3	32.3	28.0	198.8	168.7	1.1	2.8
70	hardwood	466	13.9	18.3	3.4	3.2	34.2	32.6	0.5	0.5
	total	2181	14.4	18.0	35.7	31.2	233.0	201.2	1.6	3.3
	conifer	1631	15.8	17.8	31.8	27.8	203.5	175.8	0.5	2.5
80	hardwood	435	14.3	19.1	3.8	3.6	38.9	37.7	0.5	0.5
	total	2066	14.8	18.7	35.6	31.4	242.4	213.5	0.9	3.0
	conifer	1554	16.0	18.1	31.2	24.3	204.5	178.2	0.1	2.3
90	hardwood	410	14.7	19.8	4.2	4.0	43.0	42.0	0.4	0.5
	total	1965	15.1	19.2	35.4	31.3	247.4	220.2	0.5	2.7
	conifer	1482	16.2	18.3	30.4	26.7	203.0	177.8	-0.1	2.0
100	hardwood	388	15.1	20.3	4.5	4.3	46.5	45.5	0.3	0.5
	total	1871	15.4	19.6	34.9	31.0	249.5	223.2	0.2	2.5
	conifer	1414	16.3	18.4	29.6	26.0	200.2	175.5	-0.3	1.8
110	hardwood	368	15.4	20.7	4.9	4.6	49.4	48.4	0.3	0.4
	total	1782	15.7	19.9	34.5	30.6	249.6	224.0	0.0	2.3
	conifer	1349	16.5	18.5	28.8	25.3	196.4	172.3	-0.4	1.6
120	hardwood	349	15.7	21.1	5.2	4.9	52.0	50.9	0.3	0.4
	total	1698	16.0	20.2	34.0	30.2	248.4	223.2	-0.1	2.1
	conifer	1287	16.6	18.5	28.0	24.6	192.2	168.5	-0.4	1.5
130	hardwood	332	16.0	21.3	5.5	5.1	54.3	52.9	0.2	0.4
	total	1619	16.2	20.4	33.5	29.7	246.4	221.4	-0.2	1.9
	conifer	1227	16.8	18.5	27.2	23.8	187.6	164.4	-0.5	1.3
140	hardwood	315	16.3	21.5	5.7	5.4	56.2	54.7	0.2	0.4
	total	1543	16.5	20.5	32.9	29.2	243.8	219.1	-0.3	1.7
	conifer	1171	16.9	18.5	26.4	23.2	183.0	160.1	-0.5	1.2
150	hardwood	299	16.7	21.7	6.0	5.6	57.9	56.2	0.2	0.4
	total	1470	16.8	20.6	32.4	28.8	240.9	216.3	-0.3	1.6

[a]Average stand DBH is derived from estimated total basal area and the number of trees/ha.

[b]Hardwood yield component is derived by subtraction to maintain additivity.

Table C4. Estimates of preliminary yield per hectare for spruce-fir forest types of northwestern Ontario by stand components.

SITE INDEX: 20

Stand age (yr)	Species component	Density (trees/ha)	DBH[a] (cm)	Height (m)	Basal area (m^2) (>1.5 cm)	Basal area (m^2) (≥10 cm)	Volume (m^3) (>1.5 cm)	Volume (m^3) (≥10 cm)	CAI (m^3)	PAI (m^3)
	conifer	6156	6.4	8.8	19.8	8.4	60.9	20.7	0.0	3.0
20	hardwood[b]	2127	5.1	13.9	0.2	0.0	9.0	3.2	0.0	0.4
	total	8283	5.5	12.2	20.0	8.4	69.9	23.9	0.0	3.5
	conifer	2792	11.3	13.7	27.9	17.6	128.2	70.7	6.7	4.3
30	hardwood	988	9.2	16.9	1.0	0.6	18.0	10.6	0.9	0.6
	total	3781	9.9	15.9	28.9	18.2	146.2	81.3	7.6	4.9
	conifer	2083	14.1	17.2	32.4	24.5	186.9	129.9	5.9	4.7
40	hardwood	667	11.9	19.3	1.9	1.4	27.4	21.0	1.0	0.7
	total	2751	12.6	18.6	34.3	25.9	214.3	150.9	6.8	5.4
	conifer	1827	15.5	19.6	34.5	28.3	228.2	178.9	4.2	4.6
50	hardwood	536	13.5	21.1	2.6	2.2	32.0	32.1	0.9	0.7
	total	2363	14.1	20.6	37.1	30.5	265.2	211.0	5.1	5.3
	conifer	1693	16.3	21.2	35.2	30.0	254.3	212.2	2.6	4.2
60	hardwood	470	14.4	22.7	3.2	2.9	45.5	42.5	0.9	0.8
	total	2163	15.0	22.2	38.4	32.9	299.8	254.7	3.5	5.0
	conifer	1599	16.7	22.2	35.1	30.5	268.5	231.8	1.4	3.8
70	hardwood	430	15.0	24.0	3.7	3.5	53.2	51.4	0.8	0.8
	total	2029	15.6	23.4	38.8	34.0	321.7	283.2	2.2	4.6
	conifer	1520	17.0	22.8	34.6	30.4	274.9	241.6	0.6	3.4
80	hardwood	402	15.5	25.1	4.2	3.9	59.8	58.8	0.7	0.7
	total	1922	16.0	24.3	38.8	34.3	334.7	300.4	1.3	4.2
	conifer	1448	17.3	23.2	33.9	29.8	276.2	244.9	0.1	3.1
90	hardwood	379	15.9	25.9	4.6	4.4	65.4	64.9	0.6	0.7
	total	1828	16.4	25.0	38.5	34.2	341.6	309.8	0.7	3.8
	conifer	1381	17.5	23.4	33.1	29.1	274.3	244.3	-0.2	2.7
100	hardwood	359	16.3	26.6	5.0	4.7	70.2	69.8	0.5	0.7
	total	1740	16.7	25.5	38.0	33.8	344.5	314.1	0.3	3.4
	conifer	1317	17.6	23.6	32.2	28.4	270.4	241.3	-0.4	2.5
110	hardwood	340	17.0	27.1	5.3	5.0	74.3	73.8	0.4	0.7
	total	1658	17.0	25.9	37.5	33.4	344.6	315.1	0.0	3.1
	conifer	1257	17.8	23.7	31.3	27.6	265.3	236.8	-0.5	2.2
120	hardwood	323	17.3	27.6	5.6	5.3	77.7	77.2	0.3	0.6
	total	1580	17.3	26.3	37.0	32.9	343.0	314.0	-0.2	2.9
	conifer	1199	18.0	23.7	30.4	26.8	259.5	231.6	-0.6	2.0
130	hardwood	306	17.3	27.9	6.0	5.6	80.6	80.0	0.3	0.6
	total	1506	17.5	26.5	36.4	32.4	340.2	311.6	-0.3	2.6
	conifer	1144	18.1	23.7	29.6	26.0	253.4	225.9	-0.6	1.8
140	hardwood	291	17.7	28.2	6.3	5.9	83.2	82.3	0.3	0.6
	total	1435	17.8	26.7	35.8	31.9	336.6	308.3	-0.4	2.4
	conifer	1091	18.3	23.8	28.7	25.2	247.2	220.1	-0.6	1.6
150	hardwood	276	18.0	28.4	6.5	6.2	85.4	84.3	0.2	0.6
	total	1368	18.1	26.8	35.3	31.4	332.6	304.4	-0.4	2.2

[a]Average stand DBH is derived from estimated total basal area and the number of trees/ha.

[b]Hardwood yield component is derived by subtraction to maintain additivity.

Table C5. Estimates of preliminary yield per hectare for spruce-fir forest types of northwestern Ontario by stand components.

SITE INDEX: 25

Stand age (yr)	Species component	Density (trees/ha)	DBH[a] (cm)	Height (m)	Basal area (m^2) (>1.5 cm)	Basal area (m^2) (≥10 cm)	Volume (m^3) (>1.5 cm)	Volume (m^3) (≥10 cm)	CAI (m^3)	PAI (m^3)
	conifer	5828	6.8	10.7	21.1	8.9	76.9	26.5	0.0	3.9
20	hardwood[b]	2003	5.4	17.1	0.2	0.1	12.9	4.6	0.0	0.6
	total	7832	5.9	15.0	21.3	9.0	89.8	31.1	0.0	4.5
	conifer	2643	12.0	16.6	29.8	18.9	161.8	90.5	8.5	5.4
30	hardwood	931	9.7	20.9	1.1	0.6	25.9	15.4	1.3	0.9
	total	3575	10.5	19.4	30.9	19.5	187.7	105.9	9.8	6.3
	conifer	1973	15.0	20.9	34.6	26.2	235.7	166.2	7.4	5.9
40	hardwood	628	12.6	23.7	2.0	1.5	39.5	30.4	1.4	1.0
	total	2601	13.4	22.8	36.6	27.7	275.2	196.6	8.7	6.9
	conifer	1730	16.5	23.8	36.9	30.3	288.2	228.9	5.2	5.8
50	hardwood	504	14.3	26.1	2.7	2.4	52.4	46.1	1.3	1.0
	total	2235	15.0	25.3	39.6	32.7	340.6	275.0	6.5	6.8
	conifer	1603	17.3	25.7	37.6	32.1	320.9	271.5	3.3	5.3
60	hardwood	442	15.3	28.0	3.4	3.1	64.1	60.4	1.2	1.1
	total	2045	16.0	27.2	41.0	35.2	385.0	331.9	4.4	6.4
	conifer	1513	17.8	26.9	37.5	32.6	339.0	296.7	1.8	4.8
70	hardwood	405	16.0	29.6	4.0	3.8	74.2	72.4	1.0	1.1
	total	1919	16.6	28.7	41.5	36.4	413.2	369.1	2.8	5.9
	conifer	1439	18.1	27.6	36.9	32.4	347.1	309.1	0.8	4.3
80	hardwood	378	16.5	30.9	4.5	4.3	82.7	82.3	0.9	1.0
	total	1818	17.0	29.8	41.4	36.7	429.8	391.5	1.7	5.4
	conifer	1371	18.3	28.1	36.2	31.9	348.7	313.5	0.2	3.9
90	hardwood	357	16.9	32.0	4.9	4.6	90.0	90.3	0.7	1.0
	total	1728	17.4	30.7	41.1	36.5	438.7	403.7	0.9	4.9
	conifer	1307	18.5	28.4	35.3	31.1	346.3	312.7	-0.2	3.5
100	hardwood	338	17.3	32.8	5.3	5.1	96.1	96.7	0.6	1.0
	total	1645	17.7	31.3	40.6	36.2	442.4	409.4	0.4	4.4
	conifer	1247	18.7	28.6	34.4	30.3	341.4	308.8	-0.5	3.1
110	hardwood	320	17.7	33.5	5.7	5.4	101.2	101.9	0.5	0.9
	total	1568	18.0	31.8	40.0	35.7	442.6	410.7	0.0	4.0
	conifer	1190	18.9	28.7	33.4	29.5	335.0	303.1	-0.6	2.8
120	hardwood	304	18.0	34.0	6.0	5.7	105.5	106.2	0.4	0.9
	total	1494	18.3	32.2	39.5	35.2	440.5	409.3	-0.2	3.7
	conifer	1135	19.1	28.7	32.5	28.6	327.7	296.4	-0.7	2.5
130	hardwood	288	18.4	34.4	6.4	6.1	109.2	109.7	0.4	0.8
	total	1424	18.6	32.5	38.9	34.7	436.9	406.1	-0.4	3.4
	conifer	1083	19.3	28.8	31.6	27.8	320.0	289.2	-0.8	2.3
140	hardwood	274	18.8	34.7	6.7	6.3	112.3	112.6	0.3	0.8
	total	1357	18.9	32.7	38.3	34.1	432.3	401.8	-0.5	3.1
	conifer	1033	19.4	28.8	30.7	27.0	312.1	281.6	-0.8	2.1
150	hardwood	260	19.2	34.9	7.0	6.6	115.0	115.1	0.3	0.8
	total	1293	19.2	32.9	37.7	33.6	427.1	396.7	-0.5	2.8

[a]Average stand DBH is derived from estimated total basal area and the number of trees/ha.

[b]Hardwood yield component is derived by subtraction to maintain additivity.

APPENDIX C

Table C6. Estimates of preliminary yield per hectare for spruce-fir forest types of northwestern Ontario by stand components.

SITE INDEX: 30

Stand age (yr)	Species component	Density (trees/ha)	DBH[a] (cm)	Height (m)	Basal area (m^2) (>1.5 cm)	Basal area (m^2) (≥10 cm)	Volume (m^3) (>1.5 cm)	Volume (m^3) (≥10 cm)	CAI (m^3)	PAI (m^3)
	conifer	5574	7.1	12.5	22.3	9.4	93.1	32.5	0.0	4.7
20	hardwood[b]	1907	5.7	20.3	0.2	0.1	17.1	6.2	0.0	0.8
	total	7481	6.2	17.7	22.5	9.5	110.2	38.7	0.0	5.5
	conifer	2528	12.6	19.4	31.4	19.9	195.8	110.7	10.3	6.5
30	hardwood	886	10.2	24.8	1.2	0.7	34.0	20.8	1.7	1.1
	total	3415	11.0	23.0	32.6	20.6	230.3	131.5	12.0	7.7
	conifer	1886	15.7	24.4	36.5	27.6	285.2	203.2	8.9	7.1
40	hardwood	597	13.3	28.2	2.1	1.7	52.4	40.8	1.8	1.3
	total	2484	14.1	26.9	38.6	29.3	337.6	244.2	10.7	8.4
	conifer	1654	17.3	27.8	38.9	32.0	348.7	280.1	6.3	7.0
50	hardwood	480	15.0	30.9	2.9	2.5	69.2	61.4	1.7	1.4
	total	2135	15.8	29.9	41.8	34.5	417.8	341.5	8.0	8.4
	conifer	1533	18.2	30.0	39.7	33.9	388.7	332.2	4.0	6.5
60	hardwood	421	16.1	33.2	3.6	3.3	84.0	79.9	1.5	1.4
	total	1954	16.8	32.2	43.3	37.2	472.3	412.1	5.4	7.9
	conifer	1447	18.7	31.4	39.5	34.5	410.2	362.9	2.2	5.9
70	hardwood	385	16.8	35.1	4.2	3.9	96.7	95.4	1.3	1.4
	total	1833	17.4	33.9	43.7	38.4	506.9	458.3	3.5	7.2
	conifer	1376	19.0	32.3	39.0	34.3	419.9	378.2	1.0	5.2
80	hardwood	360	17.3	36.7	4.7	4.4	107.4	107.9	1.1	1.3
	total	1736	17.9	35.2	43.7	38.7	527.3	486.1	2.0	6.6
	conifer	1311	19.2	32.9	38.1	33.7	421.9	383.5	0.2	4.7
90	hardwood	339	17.8	37.9	5.2	5.1	116.3	117.8	0.9	1.3
	total	1651	18.3	36.2	43.3	38.6	538.2	501.3	1.1	6.0
	conifer	1250	19.5	33.2	37.2	32.9	418.9	382.5	-0.3	4.2
100	hardwood	321	18.2	38.9	5.6	5.3	123.8	125.8	0.7	1.2
	total	1572	18.6	37.0	42.8	38.2	542.7	508.3	0.4	5.4
	conifer	1193	19.7	33.4	36.2	32.1	413.0	377.8	-0.6	3.8
110	hardwood	304	18.6	39.7	6.0	5.7	129.9	132.2	0.6	1.2
	total	1498	18.9	37.6	42.2	37.8	542.9	510.0	0.0	4.9
	conifer	1138	19.9	33.6	35.2	31.1	405.3	370.8	-0.8	3.4
120	hardwood	289	19.0	40.3	6.4	6.1	135.1	137.4	0.5	1.1
	total	1427	19.3	38.1	41.6	37.2	540.4	508.2	-0.3	4.5
	conifer	1086	20.0	33.6	34.3	30.2	396.5	362.6	-0.9	3.0
130	hardwood	274	19.4	40.8	6.7	6.4	139.5	141.6	0.4	1.1
	total	1360	19.6	38.4	41.0	36.6	536.0	504.2	-0.4	4.1
	conifer	1036	20.2	33.7	33.3	29.4	387.2	353.7	-0.9	2.8
140	hardwood	260	19.7	41.2	7.1	6.7	143.2	145.1	0.4	1.0
	total	1296	19.9	38.7	40.4	36.1	530.3	498.9	-0.6	3.8
	conifer	988	20.4	33.7	32.3	28.5	377.6	344.5	-1.0	2.5
150	hardwood	247	20.1	41.4	7.4	7.0	146.4	148.1	0.3	1.0
	total	1236	20.2	38.9	39.7	35.5	524.0	492.6	-0.6	3.5

[a]Average stand DBH is derived from estimated total basal area and the number of trees/ha.

[b]Hardwood yield component is derived by subtraction to maintain additivity.